

Modification and designing a solar car for educational purposes

Author Name: ekram hadi saleh alaskaree

Technical Instructors Training Institute /The Middle Technical University - Baghdad / Iraq

Email: ekramhs2000@gmail.com

Abstract:

Our research was based on basic calculations of solar cells, and the amount of power generated by including the appropriate wattage and this ability with the engines operating within the limits of solar cells And resolutely enough to move the vehicle promptly where the weight of the cells with the weight of the vehicle which is the main obstacle in design and require practical experience as well as scientific expertise on energy produced from solar cells with calculations of vehicle dynamics and other things so search gearbox torque adapter to secure sufficient torque to special drawing powers the vehicle also took into account the continuous walking accounts how panels work in various weather conditions necessitated that the power adapter is designed for the purpose of Converting energy from the panels to the unit.

In the first second half the car went m1.44 linear velocity was ≈ 5.2 m/sec determined = 1N.m, rotational speed r.p.m 250 after 1 m linear speeds 0.92 went 3 315 m/sec rotational speed r.p.m 160 which slowed its speed in writing cycling conversely increased torque to 2N.m, Applies to its equation $T = P/2 \pi N$ and equation note that torque inversely proportional to rotational speed ($T \propto 1/N$) thereby increasing wattage capacity it proportional torque by torque equation above.

Key words: solar panel, power, RPM (N), efficiency, torque, distance, convertor charging, solar car.

Symbols used:

D: distance (m) - **t:** time (sec) - **P_{out}:** net power (watt) - **v:** velocity (m / s) - **N:** revolutions (RPM) - **A:** current (Amp) - **T:** Torque (Nm) - **ζ:** eff% - **P_{app}:** inside power (watt).

1 - Introduction :

Sun said in a 26 verse in the Koran and have Surah verses especially an Ash-Shams The sun is a source of inexhaustible energy and for us to imagine how the sun is a tremendous source of energy if we know that the solar energy that falls on the globe in less than half an hour is enough of the civilized world as a whole consumption for full year. And [1] of solar energy reaching the Earth equivalent of 5,000 times the energy generated from all other sources, our research deals with solar-powered car, rather than the manufacture of gasoline.

Solar Car is a vehicle fitted with solar panels on the roof greets the sun's rays and convert them into electrical energy. Pass this energy through the control and regulation of power to suit the engine or engines, which manages wheels of this vehicle, with attention during the design of such a vehicle taking into account, inter alia, light weight, durability and reliability in the selection of the constituent materials of such vehicle departments. And this vehicle depends on the sun only in engine management so-called 'solar car. [1]

In case of clouds or dust moving the car less energy depending on you clouds and dust. But in the winter it can be charging the car with electricity for days until the sun appears. It should be noted that the more weight you need car more energy and thus more space for solar panels. [2]

2. Find the problem:

This research seeks to identify the exploitation of solar energy as an alternative for depleted fuel (gasoline) in cars run, especially in the current situation of desperate the major countries on oil and its derivatives as well as environmental problems resulting from the use of fossil fuels and the resulting exhaust in cars and toxic gases caused permeated in the health ecosystem.

2-1 Aim of the research:

The research aims to achieve the following:

1. Find out how important the use of solar energy alternative to conventional fuel in the car to run as energy.
2. study how solar energy converted directly into electrical energy by solar cells.
3. Identify the linkage type used in solar car design.
4. Try the impact of use of solar energy alternative for gasoline economic and energy save money and clean energy which does not produce exhaust as energy survey.
5. car as a model of education for the students of the machines and equipment department in the preparation of the Institute of trained technicians.

3. The importance of research: -

3-1 The importance of the research of the following key factors:

1. urged the engineering staff on the actual and the widespread use of solar energy in our country despite the fact that our country is a country of the sun.
2. increasing need to look for alternatives to fossil fuels and oil to run vehicles in particular, which represents the combustion exhaust where approximately 70% of the environmental pollution factors as well as the possibility of developing the project to project larger size for the purposes of daily use in the atmosphere of sunny Kojoa Iraq.
3. Iraq is one of the sunny countries [1] up to 95% of sunny days a year, which means a high possibility of the success of such projects if the culture has created a crisis.

4. circulating the idea and raise awareness of renewable energies at different segments of the segments of the society and start Bacassap students with the necessary skills to develop these ideas into creative ideas later, to open new horizons of learning beyond the traditional school curriculum framework.

4. Research Methodology:

Researcher using descriptive approach and the practical and analytical in the design and implementation of solar car to the fact that the practical side of the most suitable Applied roads, researcher has used the theoretical and practical sources. It consists theoretical sources of specialized books and scientific journals, either process sources included experiments were carried out on the car after complete them to measure distances and velocities were determined and the work schedule of readings and then the ability and torque and drawing diagrams for the purposes of research and development expense.

5. Previous studies:

Spans the history of the use of solar energy into the era of the Chaldeans in Mesopotamia when he used the priests of the temples in that era of time vessels with a golden coating for lighting the altar, using solar radiation [2].

The historical development of solar energy research and includes the stages of the development of power generation from the sun technology.

At the beginning of the thirties to early fifties has been found materials and devices capable of converting the sun's energy into electrical energy electrical resistance affected Once exposed to light has been the discovery of their own free Alsdvh.ovi the years that followed has not been any

significant progress in the development of research for the use of solar energy for the postwar period first World and until the beginning of World war II, in the years of the (1941) through (1946) was in the Soviet Union to develop commercial solar machine by Molière in the city of Tashkent [3].

[4] The invention of solar cells back to the beginning of the forties of the last century, specifically in 1941, where he managed the American inventor Russell Uhl of the production of the first solar cell, made of silicon.

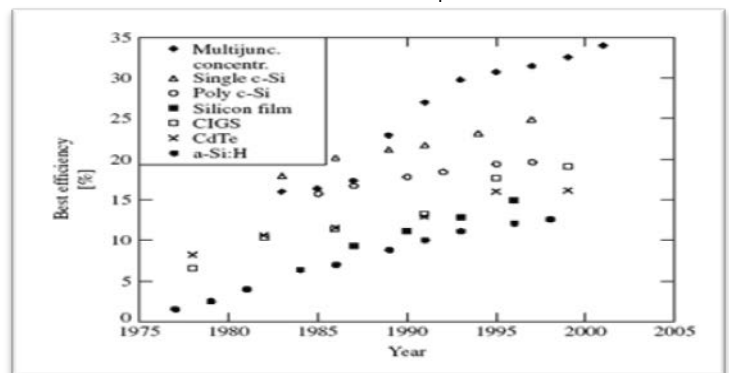
And then studies and research for the production of solar cells rolled. Studies have evolved to take advantage of the possibility of solar cells in electric power generation.

Especially in light of the crises suffered by the electricity sector in the world, whether the repeated rupture as a

التصنيف	الرمز	الاسم
1- Elemental	Si	Silicon
	Ge	Germanium
2- Components		
a) IV - IV	SiC	Silicon carbide
b) III - V	AlP	Aluminum phosphide
	AlAs	Aluminum arsenide
	AlSb	Aluminum antimonide
	GaN	Gallium nitride
	GaP	Gallium phosphide
	GaAs	Gallium arsenide
	GaSb	Gallium antimonide
	InP	Indium phosphide
	InSb	Indium antimonide
c) II - VI	ZnO	Zinc Oxide
	ZnS	Zinc sulfide
	ZnSe	Zinc selenide
	ZnTe	Zinc telluride
	CdS	Cadmium sulfide
	CdSe	Cadmium selenide
	CdTe	Cadmium telluride
d) IV - VI	PbS	Lead sulfide
	PbSe	Lead selenide
	PbTe	Lead telluride

result of rising conventional fuel prices globally, or the creation of fuel used in power generation of serious damage to health and the environment and climate.

Table -1 the names of elements and compounds used in solar cells



and symbols processing and classification [11].

figure -1 shows the relationship between efficiency and Year.

The solar cells volt adapters light works to convert direct sunlight into electricity, and are made of semiconductors are often made of silicon chemically treated; to give one side a positive charge, and by another negative charge, a reliable and environmentally friendly safe, and lifetime of up to twenty years.

At the beginning of the fifties when it was developing high-power chips for silicon it has been developed and certain forms capable of converting sunlight into electrical energy efficiently transform geometric dimensions (6%).

The fifties and sixties period is another important area of interest in solar power as an alternative energy source, some of the material has been tested Kalpsmot and germanium by Baum (Baum) [5].

The second half of the seventies of the Arabs announced the ban on the export of oil to the West began to give many countries a very interesting solar-powered and use. [6] This period resulted in the deployment and development of solar energy technology, where use spread in many areas such as: communications -oanaki -walanarh ...

But in the late nineties, scientists in "Spktrulab register a new increase in the manufacturing capacity of solar cells, where registered converting 32.3% of the solar incoming energy into electric current, and this percentage is twice as old cell manufacturing capacity, scientists believe that they can this percentage increased to 40%.

[7] The second millennium in 2002, increased the amount of energy that is absorbed in one hour for the amount of energy that has been used in the world in one year. [8] The amount of solar energy reaching the surface of extremely large ground, so much so that they are up to one year

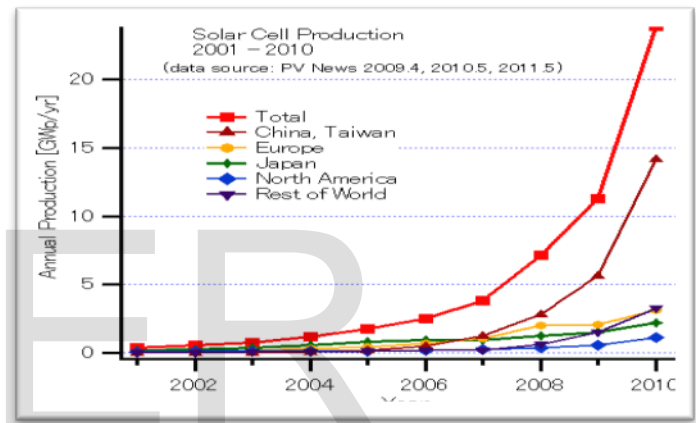
To about twice what will be obtained from energy sources on the ground combined together, such as coal, petroleum, natural gas and uranium, which is extracted from the ground. [9] photosynthesis consumes about 3,000 EJ of solar energy in the formation of biomass. I decided Honda Japanese general ((2006 creation of a large assembly plant and the manufacturing of photovoltaic panels a capacity of 27.5 megawatts, defying an old rival companies in the solar cell industry, such as Sharp, Mitsubishi, Kyosei Ra and others at a cost of roughly \$ 86 million, and the company says that it has taken this step as a start the decision to manufacture environmentally friendly solar-powered and

commercially cars, but at the same time they can sell these panels in the global market revenues of between 40 to 70 million dollars a year, the company will use the new technologies is semiconductor silicon conductors that export ratio of carbon and instead would use materials less productive carbon by up to 50 percent, and will build the plant near the city of automobile production in Coma Moto south-west of Japan. [10]

In 2007, the power plant that produces electricity capacity of 14 megawatts (MW) in Clark County in Nevada has become, as well as the plant operating capacity of 20 MW in

Bieniek medal in Spain said two features on the trend

towards the establishment of solar power plants giant strenuous in the United States and Europe [11. and as a source of renewable energy, solar energy requires supportive source, which could be the wind partially. This



is usually to get this support from the batteries, but the devices are typically used hydroelectric power that is

figure- 2 The following diagram shows the relationship between solar products in a number of States and the amount of acceleration over the years from 2002 until 2010.

stored by pumping. The power generation Technology Institute

Solar at the University of Kassel test connected to a virtual power plant system to store energy, where energy can be generated from solar energy or wind power or biogas hydroelectric energy that is

stored by pumping, to provide enough energy for use on an ongoing basis; so that the project depends on all renewable sources. [12].

5. The materials used in the solar car-making:

1-solar cells: -add (2 board) VDC, 12 volts per slab of panels and strongly 0.95 mA current for each of the tables.

2- 10-volt battery (2)

3-electric engine number two, one for the front and back pay, and the second rotated and guidance.

4-wheels and components of the gearbox can be installed to take advantage of lower torque generated, the electric motor.

5-car test after the completion of design, operation and expense generated power and torque generated some Figure -2

changes with a time of operation or testing distance. And other Altsamamh and mathematical equations.

6. The theoretical part:

Solar energy is emitted light and heat from the sun which the human Btschaarhama to his advantage since ancient times using a range of media technology that is constantly evolving. Most of the renewable energy available sources traced on the surface of the Earth to solar radiation as well as secondary sources of energy, such as wind and wave energy, hydropower and biomass .. it is important here to mention that only a small part of the solar energy available in our lives is not used.

Receives the planet Beta 174 watts of solar radiation coming to him (solar radiation) at the upper atmosphere. [1] and reflected approximately 30% of this radiation back into space while the rest is absorbed by clouds, oceans and land masses. Most of the spectrum of solar light on the Earth's surface via video-term spreads and near extent of infrared radiation in addition to the spread of a small portion of it near the extent of ultraviolet radiation. [2] absorbing surfaces land and ocean and atmospheric solar radiation, and lead to overheating. Hot air that contains the rising ocean water vapor, causing atmospheric air circulation feature or heat load in the direction of vertical transmission rises. When air rises to the peaks of the highlands, where the temperature drops, the water vapor condenses in the form of withdrawal of raining on the Earth's surface, and then place the water cycle in the universe. Increase the latent heat of condensation process of heat transfer characteristic of pregnancy, leading to the occurrence of certain weather phenomena, such as wind and hurricanes countermeasures. [3] and working spectra of the sun absorbed by the oceans and land masses held by the degree to become Earth's surface an average temperature of 14°C light. [4] Through photosynthesis carried out by the process of green plants, the solar energy is converted into chemical energy, which leads to the production of food, wood and biomass, which is extracted from fossil fuels.

The following table shows the names of elements and compounds used in solar cells and symbols processing and classification [11]

[11] The following diagram (figure -1) shows the

relationship between efficiency and time each year to show the best materials efficiency in solar panel manufacturing.

time each year to show the best materials efficiency in solar panel manufacturing

The [1] solar energy reaching the Earth equivalent of 5,000 times the energy generated from all other sources.

Can convert direct sunlight into electricity using Voltodoiah adapters (PV) and the process of concentrating solar power (CSP) and many other experimental methods. PV converters are used primarily for the supply of small and medium-sized electric devices, starting with the calculator, which is operated by a single solar cell to homes that do not contain the power grid, which is supplied with electricity by a group of photovoltaic cells. The electricity is generated on a large scale by concentrating solar radiation stations, but now has become a photovoltaic arrays Aljhdah plants that produce a large amount of electricity, such as plants, "SES GSM" more common. In 2007, the power plant that produces electricity capacity of 14 MW located in Clark County in Nevada has become, as well as the plant operating capacity of 20 MW in Banieksama in Spain said two features on the trend towards the creation of a giant Jhdah solar power plants in the United States and Europe. [2]

Solar cells have been used for the purpose of converting sunlight directly into electricity through the use of semiconductor those elements that the number of equivalence (4) and (5) and (6) Calclikun, phosphorus, sulfur, selenium, germanium and bismuth. [3]

6-1 solar cells and their types:

under study, research, and it has focused attention on the solar cell manufacturing silicon to provide silicon element in nature as well as the scientists and researchers were able to study this element extensively studied and learned about the different properties and suitability for the manufacture of crystalline solar cells and cracked mainstream.

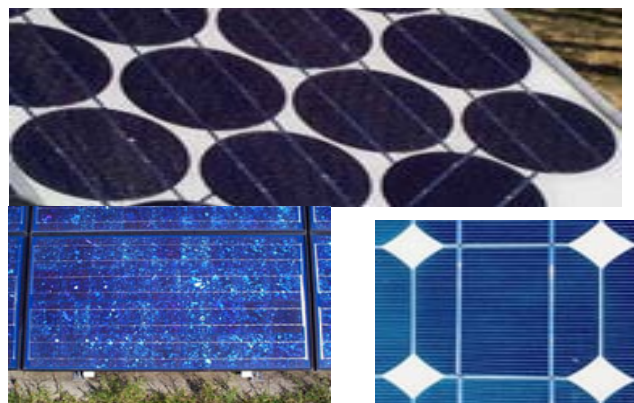


fig .4 types of silicon crystallization cells

6-2 crystalline silicon solar cells:

These cells are made of silicon rods through the development of mono silicon or several gelling then Arab to chips and treated chemically and physically through various stages to reach the solar cells.

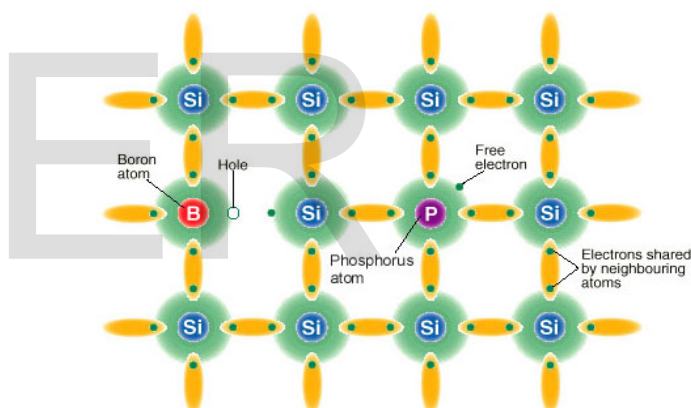
High efficiency of these cells ranging from 9-17% and monocrystalline silicon cells are expensive stream where the technical difficulty and power consumption while silicon cells many of crystallization are less expensive than single-crystallization and less efficient as well.

Material of these cells with silicon form where the crystalline composition cracked to the presence of the element hydrogen or other elements were introduced intentionally to earn a distinctive electrical properties of cells and silicon Alamo Ravi inexpensive for crystalline silicon cells, where the deposition of thin striped layer using small quantities of raw materials used in a few operations compared to manufacturing processes crystalline. The manufacture of silicon cells Alamo Ravi Ttoie and more convenient for continuous manufacture of a self-mechanism.

Efficiency of the cells of this material ranging from 4-9% for large surface area and more than a little later For small surface area, although it was affected by the stability of the solar radiation.

The solar cells of different materials manufacturing, however, most of these rare nature or its material properties of toxic pollutants to the environment or a complex manufacturing and costly, and some are still

7 - general types of solar panels and efficiency:



Material type	Efficiency degree inside factory%	Efficiency degree out side%
silicon alone crystal	24~	17 - 14
silicon numerous crystal	18~	15 - 13
Silicon non crystal	13~	7 - 5

table – 2 general types of solar panels and efficiency:

8 - Design processes: -

Used solar cells number 2 plate and the mass of 1.6 kg per board

Milan angle between the two tablets = 135 degrees,

And an area of 0.1209 m^2 = 2 tablets the area

Battery charging = 10 volts

The total mass of the car = 4 kg

(Remote control) regulator car and the direction of movement

$$P_{out} = I * V = 0.95 * 12 = 11.4 \text{ watt}$$

P_{in} = intensity of solar radiation falling * board space

The number of cells * = board space per cell area

$$\text{The first board space} = 36 * 0.06 * 0.026 = 0.05616 \text{ m}^2$$

$$\text{The second board space} = 36 * 0.06 * 0.03 = 0.0648 \text{ m}^2$$

$$= 0.0648 + 0.05616 = 0.1209 \text{ m}^2 \text{ board space 1 2 board space}$$

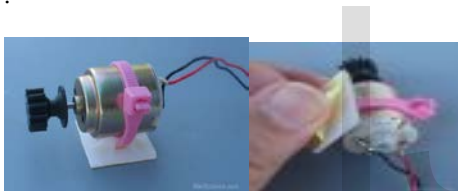
$$P_{in} = 1400 * 0.1209 = 169.26 \text{ watt efficiency Tablet cell}$$

9 - Solar cell efficiency: -

Assuming that the intensity of the solar radiation falling = watt / m^2 1400

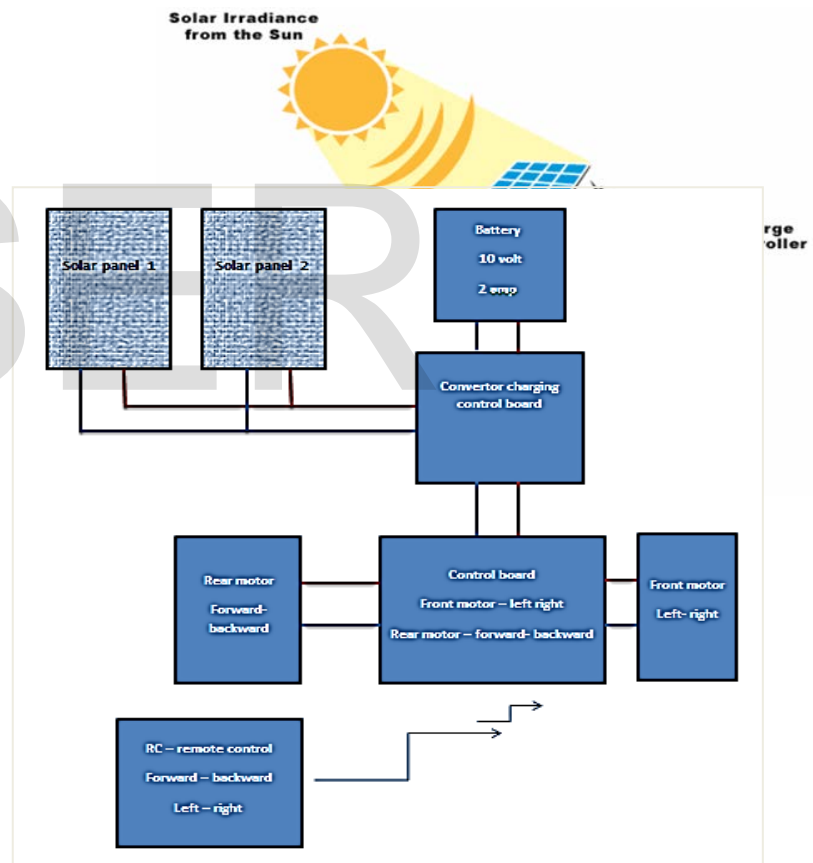
10- Engine installation:

To install the engine off the rear wheels can be used as belt or under plastic powered plastic piece on the surface to severe paste



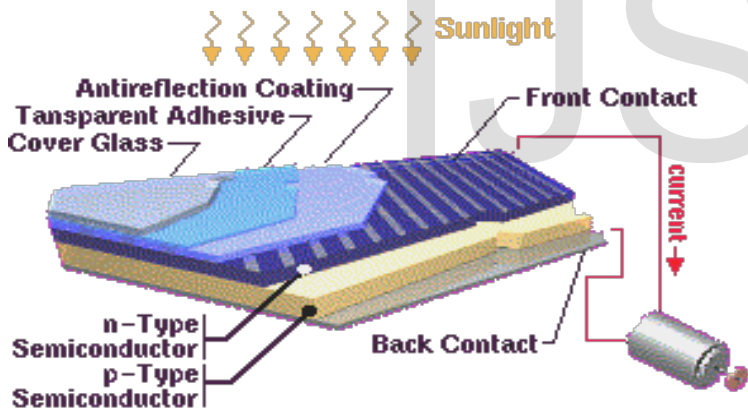
11- Solar panel installation:

Installing solar panels 45° angle is chosen for one of the other palettes 90° angle combination to get a greater amount of solar radiation. And an angle between two panels = 135° .



Torque = P / 2πN N.m Current (Amp) Eff%
RPM (N) Velocity m / s

$$\text{RPM} = \frac{V \frac{\text{m}}{\text{s}} \cdot 60000 \cdot \text{Gear ratio}}{\pi \cdot \text{Wheel Ratio (mm)}}$$



$$\text{Efficiency \%} = \frac{P_{out}}{P_{app}}$$

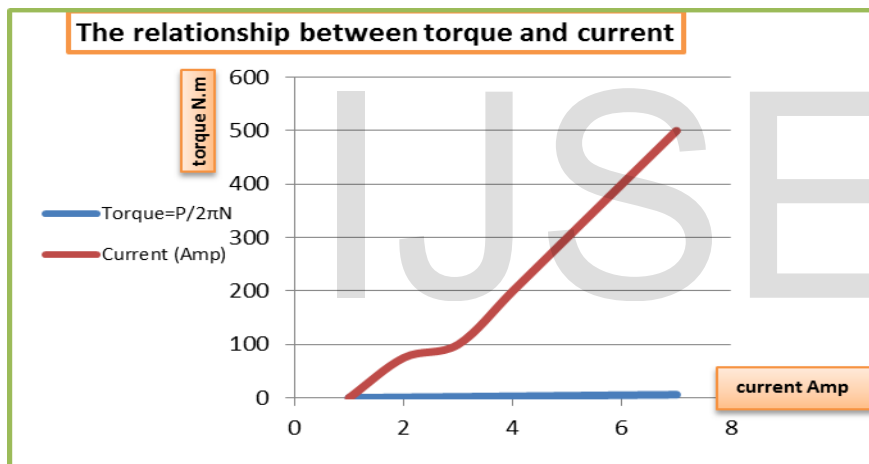
$$\eta = \frac{p_{out}}{p_{in}} = \frac{11.4}{169.2} * 100 = 6.73\%$$

13-results and accounts: -

Distance(d)(m)	Time(sec)	$P_{out}(Watt)*10^{-3}$	Velocity m/s	RPM(N)	Eff%	Currrt (Amp)	Torque= $P/2\pi N$ (N.m)
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1.44	0.5	6.3	5181	250	70	75	1
0.92	1	12.6	3315	160	60	100	2
0.57	1.2	18.9	2072	100	55	200	3
0.45	1.3	25.2	1657	80	40	300	4
0.34	2	31.5	1243	60	30	400	5
0.30	2.2	37.5	1150	50	25	500	6

Table -3- The relations between the computational results



Current (Amp)	Torque= $P/2\pi N$ N.m
75	1
100	2
200	3
300	4
400	5
500	6

Table- 4 [TEST 1]

figure -6

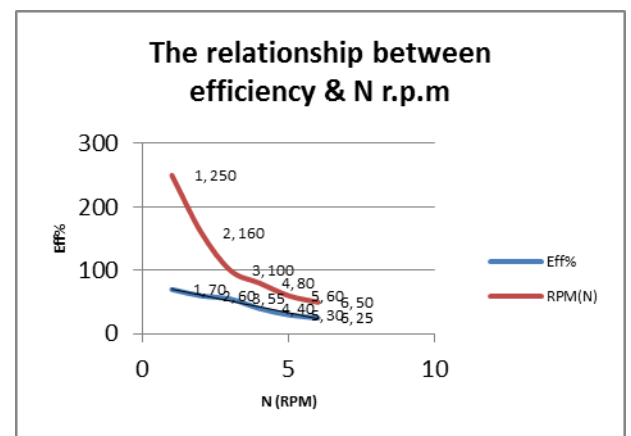
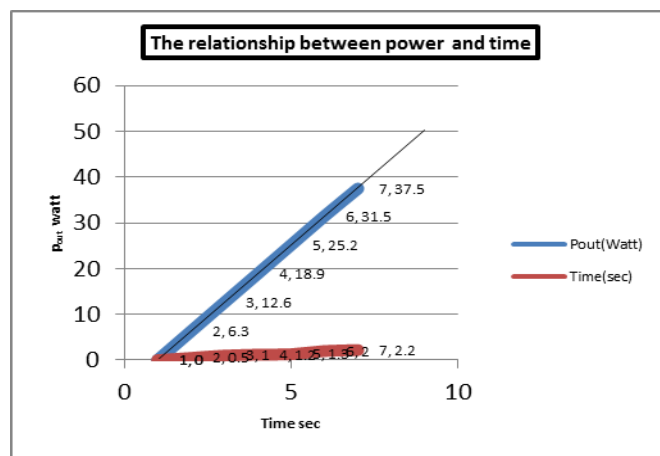
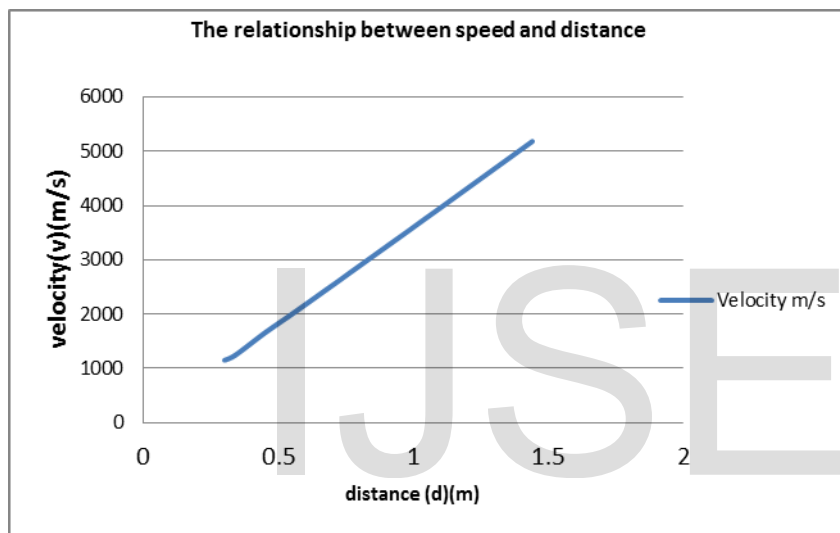


Figure-7

Figure- 8



Distance(d) (m)	Velocity m/s
1.44	5181
0.92	3315
0.57	2072
0.45	1657
0.34	1243
0.30	1150

Table-5 [TEST2]

Figure -9

Test conditions:

Sun Level % 92 %

Panel ISC 1234 ma. OCV 10.44 Volts

Electronics set Voltage Automatic 8.9 Volts

Torque mNm	RPM
	11300 Running Free
4.2	10380 Start Temp 24 Deg C
9.2	7100
15.5	3780
20.7	2270
25.7	1240 Finish Temp 34 Deg C
29.6	940
32.1	540
34.6	180
34.9	105
35.3	40 Finish Temp 32 Deg C

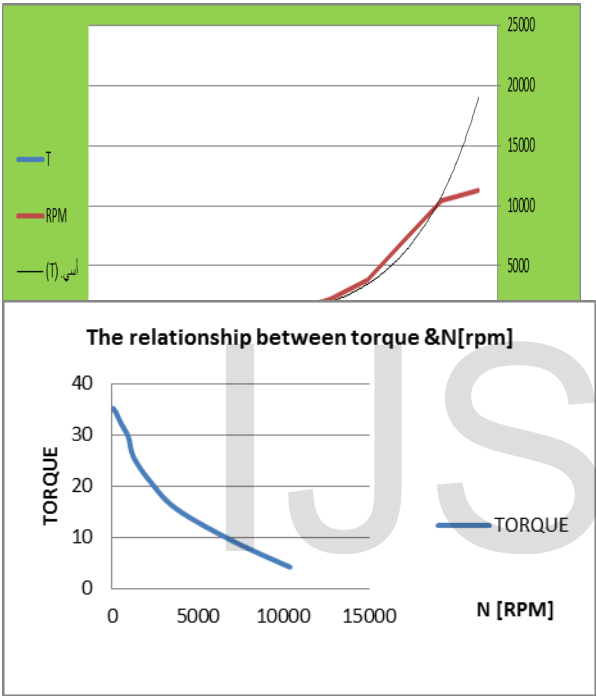


Figure -

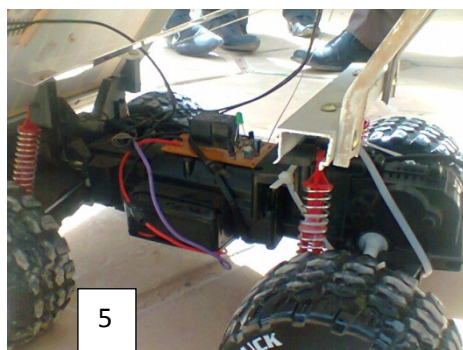
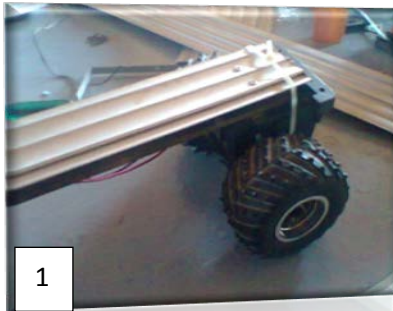
10 test 3

T	rpm
	15600
0.5	9700
1	9300
1.2	7500
1.3	7300
2	5700
2.2	5050
2.5	3900
3	3400
3.5	2600
4.8	1600
6.7	650
7.5	250
8	80

Table -6[TEST3]

Figure -11 test 4

14-action process to search:



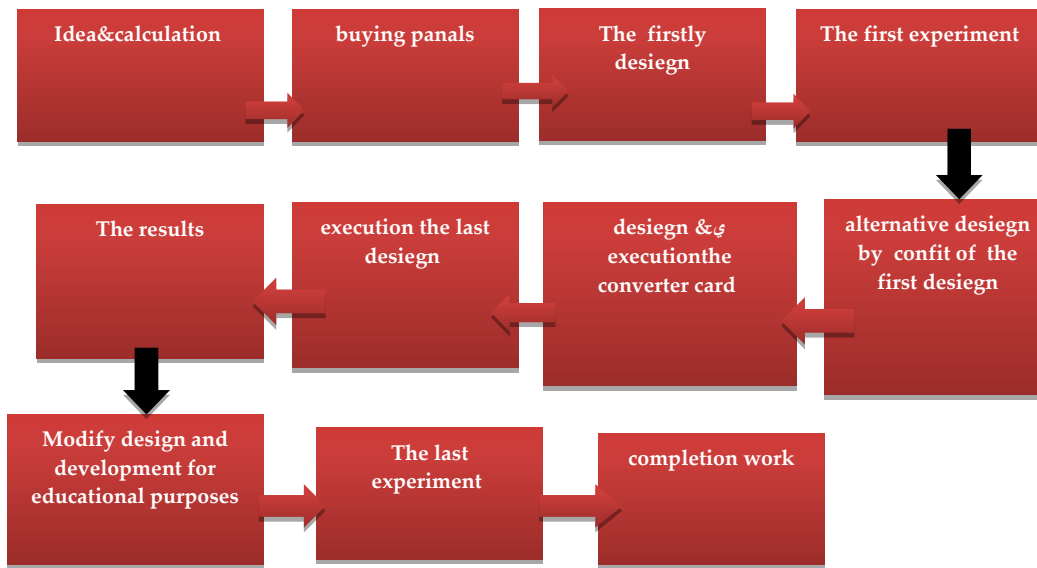


Chart -1 shows the sequence of steps scientific research and experimental and computational process and then conduct experiments to reach results and completion design .

15. discuss the results:

Include the discussion of the results and the performance of the solar car and out of the main conclusions and proposals for future action:

15.1 discussion tables and graphs:

- Through graphs (Figure (6), the relationship between the torque and current is direct relationship with less torque increased current.
- By the charts in the relationship between the torque and the current form of (1) is an inverse relationship where at least determined to increase the current.
- By the charts in the relationship between power and time it is a positive correlation was becoming increasingly with time.
- The relationship between speed and distance format (4) is an inverse relationship where at least speed up the distance.
- The relationship between the lost energy and speed (power loss with velocity) form (7) is a direct correlation to impose the car it was in standard conditions (pressure of 1 atmosphere and a temperature of 25 ° C) and there are no strong winds
- As in Figure 3, which represents the relationship between the efficiency and speed rotational we note because energy losses shown in Figure (7) that an inverse relationship to increase rotational speed less efficiency.

From all this we conclude that in the second half of the first car went 1.44 m The speed linear ≈ 5.2 m / sec and torque = 1 N.m, the rotational speed of 250 rpm and after 1 second goes 0.92m and quickly written 3.315 m / sec and the rotational speed of any 160 rpm

Reference:

- [1] Retrieved -Large-scale photovoltaic power plants. PV resources. 2008-06-27
- [2] Dr. Eng. Nouredine Al-Rubaie -Scientific Horizons for Solar Energy Investment - Department of Cultural Affairs and Publishing 1983.
- [3] Dr. Nour al-Din al-Rubaie- Baghdad -Introduction to electronic circuits / Chapter II / 1979.
- [4] <http://www.aleman.com>
- [5] Baum, U.A- Pasachoff, J. M. Astronomy Now, Sanders, Golden Sun Burst Series 1978.
- [6] The Use of Solar Energy for Electricity Production by Direct Conversion by Means of Converter and Photoelectric cell U.N. Conf. Rome, 1961.
- [7] Energy in Developing Countries - World Bank August 1980.
- [8] Archer, Cristina; Jacobson, Mark. "Evaluation of Global Wind Power". Stanford. See it on 2008-06-03.
- [9]. Food and Agriculture Organization of the United Nations -"Energy conversion by photosynthetic organizations".. See it on 2008-05-25.
- [10] Dr. Eng. Nouredine Abdullah Al-Rubaie- The scientific potential of solar energy in Iraq -. Research presented to the Iraqi Engineering Conference held in Baghdad (14-17) January 1964.
- [11] http://www.miniscience.com/kits/CAR_SOLAR/index.html
- [12] Powering the Planet: Chemical challenges in solar energy utilization
- [13] Leon, M "Mathematical modeling and thermal performance analysis of unglazed 9.transpired solar collectors This page results in the search for solar powered devices at the Emirates Securities Forum. (2007).
- [14] Müller, Reto. "Band-approximated radioactive heat transfer analysis of a solar chemical reactor for the thermal dissociation of zinc oxide".(9/2007)

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